



Title	Bees of the Mariana Islands, Micronesia, collected by the Expedition of the Natural History Museum & Institute, Chi ba (Hymenoptera, Apoidea)
Author(s)	Tadauchi, Osamu
Citation	ESAKIA 34 p215-225
Issue Date	1994-03-24
URL	http://hdl.handle.net/2324/2578
Right	

This document is downloaded at: 2012-10-12T16:00:06Z

Bees of the Mariana Islands, Micronesia, collected by the Expedition of the Natural History Museum & Institute, Chi ba (Hymenoptera, Apoidea)¹⁾

Osamu TADAUCHI

Entomological Laboratory, Faculty of Agriculture,
Kyushu University, Fukuoka, 812 Japan

Abstract. Seven species of bees are recorded, based on 146 specimens mainly collected on the Northern Mariana Islands, Micronesia, by the Expedition of the Natural History Museum & Institute, Chiba, in 1992. One new species, *Lasioglossum (Evylaeus) miyanoi* is described from Rota Is. A total of 11 new records of bees are reported from 7 islands. The Southern Marianas have a larger endemic bee fauna, while the Northern Marianas appear to have a moderate fauna with 6 bees including 2 endemic species. The fauna of the Northern Marianas is strongly related to that of the Southern Marianas and dishannonic in components;

INTRODUCTION

This paper deals with Apoidea collected by Dr. Sinya Miyano in the Northern Mariana Expedition of the Natural History Museum & Institute, Chiba, in 1992. The Mariana Islands are divided into two groups, *i.e.*, the Northern Islands from Maug to Anatahan, and the Southern Islands from Saipan to Guam (Fig. 1). The collection consists of two separate groups, 134 specimens from the Northern Islands (Maug, Agrihan, Pagan, Alamagan, Guguan and Anatahan, from north to south) and 12 specimens from the Southern Islands (Saipan and Rota). The specimens are classified into 7 species belonging to 6 genera in 4 families including one new species from Rota Island and 11 new records from 7 islands.

With respect to faunistic papers on Apoidea of Micronesia except for scattered descriptions, Fullaway (1913) presented the first report from Guam Island including 5 species. Yasumatsu (1935, 1939a, 1939b, 1942) and Cockerell (1942) reported bees of Micronesia based on the material col-

1) Contribution from the Entomological Laboratory, Faculty of Agriculture, Kyushu University, Fukuoka (Ser. 4, No. 64).

lected by the Esaki expeditions carried out from 1936 to 1940.

(5 from the South-
em, with 4 in common).

The present collection helps correct the deficiency of faunistic information on the Northern Islands with the first bee records from Maug, Alamagan, Guguan and Anatahan Islands. Six species are enumerated from the Northern Marianas and 14 from the Southern Marianas based on the present survey. New records of bees from each island are shown by asterisks in the following report.

SYSTEMATICS

Family Halictidae

1. *Homalictus vexator* (Krombein, 1950) (Fig. 3A)

Halictus (*Homalictus*) *vexator* Krombein, 1950. Proc. Hawaii. Entomol. Soc. 14: 117 [female; Agrihan Is.; type in U. S. National Museum].

Homalictus vexator: Michener, 1965. Bull. Amer. Mus. Nat. Hist., 130: 181.

Krombein (1950) listed seven species of *Homalictus* from Micronesia. Among them one is from the Northern Marianas, 3 from the Southern Marianas and 3 from the Carolines. According to the data, this species is endemic to the Northern Marianas and is common in the islands.

Specimens examined: 1.5 females, Guguan I., N. Mariana Is., 17. v. 1992 (S. Miyano); 24 females, same data as above except 18. v. 1992; 1 female, Pagan I., N. Mariana Is., 27. v. 1992 (S. Miyano); 5 females, Agrihan I., N. Mariana Is., 28. v. 1992 (S. Miyano); 37 females, same data as above except 31. v. 1992.

Distribution: Mariana Is. (Agrihan I., *Pagan I., *Guguan I.)

2. *Lasioglossum* (*Evyllaesus*) *miyanoi* Tadauchi, new species (Fig. 2A–D)

Female. Body length 5.0–5.6 mm, wing including tegula 4.2–4.4 mm.

Coloration. Black except as follows: mandible with apical third reddish brown; flagellar segments 2–10 beneath and tegula pale brownish; distitarsi and claws brownish; wings transparent with veins and stigma pale brown; metasomal terga posteriorly pale brownish.

Pilosity. Hairs whitish, partly yellow-tinted; clypeus with hairs long, decumbent, simple to poorly plumose; submarginal bristles fine; paraocular area with hairs sub-appressed, distinctly plumose; vertex with yellow-tinted hairs, relatively long, erect, sparse and poorly plumose; pronotum with dense, erect tomentum; mesoscutum with hairs erect, very short, poorly plumose, surface clearly visible; mesoscutellum similar but hairs longer; metanotum with dense tomentum, with long, erect and plumose hairs posteriorly and laterally, covering surface completely; mesopleuron with moderately dense, erect and plumose hairs, shorter above, longer below; tegula with sparse, semi-erect hairs anteriorly, glabrous distally; metasomal tergum 1 (T1) with conspicuous basolateral

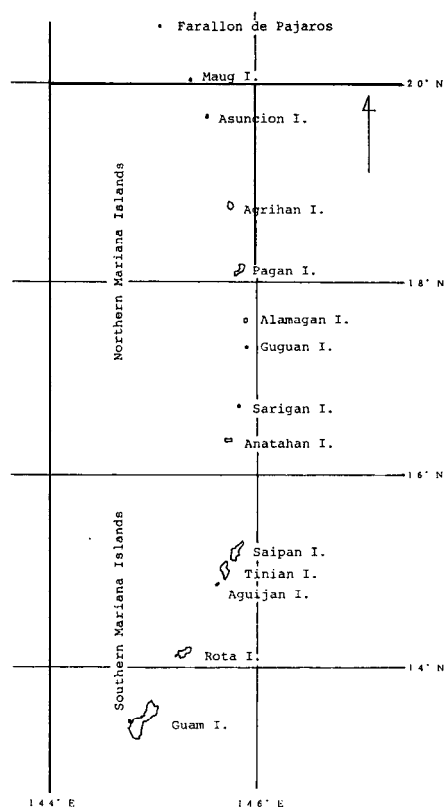


Fig. 1. A map of Mariana Islands.

Table 1. A summary of bee fauna in the Bonin Is. and Micronesia.

Islands	Total sp. no	Endemics	Endemism(%)	Introduced
Bonin Is.	8	7	87.5	1
N. Mariana Is.	6	2	33.3	1
S. Mariana Is.	14	8	57.1	2
Caroline Is.	16	9	56.3	1
Palau I.	10	6	60.0	1
Yap I.	7	5	71.4	0
Truk I.	6	2	33.3	0
Ponape I.	5	2	40.0	1
Kusaie I.	4	1	25.0	0
Marshall Is.	2	0	0.0	0

tomental patch and with long, erect hairs medially poorly plumose, and laterally distinctly plumose; hairs on disc medially sparse, simple and short; marginal area medially glabrous, submedially and laterally with sparse, simple, sub-appressed hairs; T2 anteriorly with rather conspicuous tomental band, not interrupted medially, broader laterally; disc medially with sparse, simple hairs, and denser, suberect hairs laterally; T3 and T4 with basal patches broad and not interrupted medially, hairs on disc much longer, stouter and denser; sternal scopa sparse, partly plumose.

Structure. Head oval, slightly wider than long (1.04 : 1.0), vertex convex; inner orbit distinctly convergent below; MOD (maximum interorbital distance) : UOD (upper interorbital D) : LOD (lower interorbital D) = 1.0 : 0.87 : 0.73; POD (postocellar D) : OOD (ocellocular D) : OCD (ocellocapital D) = 1.0 : 0.76 : 0.59; vertex shiny and smooth with shallow, fine (15-20 μm) punctures (=PP), interspaces (=IS) irregular, $\phi\text{P} > \text{IS}$; ocellocular area flat, smooth and shiny, with fine PP (15 μ), $\phi\text{P} < \text{IS}$; frons flat with microareolation (ϕ 20-25 μ); paraocular area with PP of 20-25 μ (IS OS-1.0 P), sparser downward, and IS smoother and more shiny; supraclypeal area moderately convex, with PP (20 μ), shallow, sparse medially, denser laterally (IS < P); clypeus below depressed; clypeus above with shallow, ill-defined PP (ϕ 15-30 μ , IS=1-1.5 P), below with irregular, obscure, elongate PP (ϕ 40-60 μ); CPL (clypeus length) : CAL (clypealveolar D=D between level of lower rims of antennal sockets and lower margin of clypeus) : APL (apical part of clypeal L=L of part exceeding lower orbital line) = 1.0 : 1.77 : 0.42.

Mesoscutum with fine (15-20 μ), weak PP, IS finely tessellate and dull, 1.0-2.0 ϕ ; mesoscutellum mildly convex, as on mesoscutum with shiny, smooth and impunctate space lateromedially; mesopleuron with irregular, coarse, transverse rugose. Propodeal dorsum with strong, longitudinal ridges, partially branching, covering whole area; SCL (mesoscutellum length) : MNL (metanotum L) : PDL (propodeal dorsum L) = 1.0 : 0.63 : 0.79; lateral and apical margin of propodeal dorsum delimited by distinct carina; legs of the usual *Lasioglossum* type; basitibial plate elongate, with apex roundly pointed; inner hind tibial spur with 3 moderately long teeth.

Metasomal terga oval; T1 both declivity and disc, shiny and transversely, very weak lincolate with sparse and fine PP, denser and coarser laterally; tergum 2-4 nearly smooth and shiny anteriorly and transversely lineolate and dully shining posteriorly, with dense, fine PP (ϕ 15 μ IS 1-2 PP); marginal area weakly depressed.

Male. Unknown.

Type material: Holotype female, Rota I., S. Mariana Is., 13. vi. 1992 (S. Miyano). Paratypes, 2 females, same data as holotype.

Type depository: The holotype and one paratype are preserved in the Natural History Museum & Institute, Chiba, and one paratype is in the Entomological Laboratory, Faculty of Agriculture, Kyushu University.

Distribution: Mariana Is. (Rota I.)

Family Megachilidae

3. *Lithurge* (*Lithurge*) *scabrosus* (Smith, 1859) (Fig. 3B)

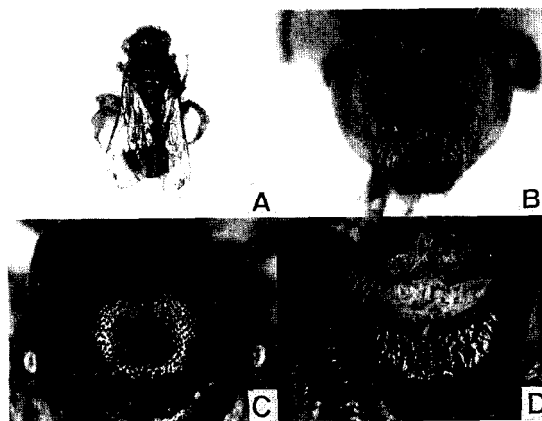


Fig. 2. *Lasioglossum (Evylaeus) miyanoi*, n. sp., A: dorsal view; B: head in frontal view; C: mesoscutum in dorsal view; D: metanotum and propodeum in dorsal view.

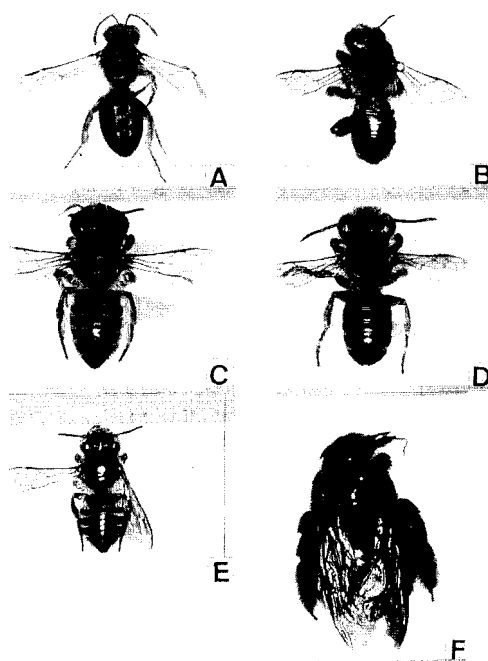


Fig. 3. Dorsal view of the bees, A: *Homalictus vexator*, female (body length=BL 5.8mm); B: *Lithurge scabrosus*, male (BL 12.7mm), C: *Megachile fullawayi*, female (BL 9.4mm); D: *M. fullawayi*, male (BL 9.1mm); E: *Megachile laticeps*, female (BL 11.4mm); F: *Xylocopa brasilianorum varipuncta* (BL 20.6mm).

Megachile scabrosus Smith, 1859. J. Proc. Linn. Soc., 3: 134 [female; Aru Is.; type in Hope Museum, Oxford Univ.].

Lithurgus albo-fimbriatus Sichel, 1867. Reise Novara, Zool., 2: 1.51 [female; Tahiti].

Lithurgus sp. Fullaway, 1913. Proc. Hawaii. Entomol. Soc., 2: 282 [Guam].

Lithurgus guamensis Cockerell, 1914. Ann. Mag. Nat. Hist. (8)14: 1 [female; Guam]; Yasumatsu, 1939. Tenthredo, 2: 333 [female & male; Saipan, Kusaie, Ponape, Truk, Palaus]; Cockerell, 1942. B. P. Bishop Mus. Bull., 172: 189.

Lithurgus albofimbriatus froggatti: Cockerell, 1914. Ann. Mag. Nat. Hist. (8) 14: 469 [female; New Hebrides].

Lithurgus scabrosus froggatti Cockerell, 1929. Rec. Austral. Mus., 17: 233.

Lithurgus scabrosus: Cockerell, 1939. Occas. Papers B. P. Bishop Mus., 15: 64 [Yap, Palaus, Ponape].

Lithurgus* (*Lithurgus*) *scubrosus: Krombein, 1950. Proc. Hawaii. Entomol. Soc., 14: 120 [Marianas, Carolines]

This species is widely distributed in Polynesia, Micronesia and Hawaii.

Specimens examined: 4 males, Guguan I., N. Mariana Is., 17. v. 1992 (S. Miyano); 1 male, same data as above except 18. v. 1992 (S. Miyano); 3 males, East I. of Maug I. of N. Mariana Is., 2. vi. 1992 (S. Miyano).

Distribution: Mariana Is. (*Maug I., Agrihan I., *Guguan I., Saipan I., Tinian I., Guam I.), Caroline Is. (Palau I., Yap I., Truk I., Ponape I., Kusaie Atoll), New Hebrides, Fiji, Samoa, Tahiti, Rarotonga, Society Is., Marquesas and Hawaii.

4. *Megachile* (*Euricharaea*) *fullawayi* Cockerell, 1914 (Fig. 3C-D)

Megachile sp. Fullaway, 1913. Proc. Hawaii. Ent. Soc., 2: 282 [Guam].

Megachile fullawayi Cockerell, 1914. Ann. Mag. nat. Hist. (8)14: 2 [female & male; Guam; type in U.S. National Museum]; Yasumatsu, 1939. Tenthredo, 2: 336 [Kusaie, Jaluit]; Yasumatsu, 1942. Tenthredo, 3: 335 [Pagan]; Cockerell, 1942. B. P. Bishop Mus. Bull., 172: 189.

Megachile* (*Euricharaea*) *fullawayi: Krombein. 1950, Proc. Hawaii. Entomol. Soc., 14: 126 [Marianas, Marshalls, Carolines].

This species is widely recorded in Micronesia including Marianas, Carolines and Marshalls.

Specimens examined: 1 female, Anatahan I., N. Mariana Is., 11. v. 1992 (S. Miyano); 1 male, Agrihan I., N. Mariana Is., 28. v. 1992 (S. Miyano); 2 females and 1 male, same data as above except 30. v. 1992; 1 male, same data as above except 31. v. 1992; 3 females and 1 male, East I. of Maug I., N. Mariana Is., 2. vi. 1992 (S. Miyano); 1 female, same data as above except 4. vi. 1992; 1 female, North I. of Maug I., N. Mariana Is., 3. vi. 1992 (S. Miyano).

Distribution: Mariana Is. (*Maug I., *Agrihan I., Pagan I., *Anatahan I., Guam I.), Caroline Is. (Yap I., Kusaie Atoll, Nukuro Atoll, Kapingamarangi Atoll) and Marshall Is. (Eniwetok Atoll, Kwajalein Atoll., Jaluit Atoll, Majuro Atoll).

5. *Megachile laticeps* Smith, 1853 (Fig. 3E)

Megachile laticeps Smith, 1853. Cat. Hym. Brit. Mus., 1: 183 [male; Philippines; type in British

- Museum]; Cockerell, 1939. Occas. Papers B. P. Bishop Mus., 1.5: 63 [female & male; Carolines]; Yasumatsu, 1942. Tenthredo, 3: 337; Cockerell, 1942. B. P. Bishop Mus. Bull., 172: 188 [Guam]; Krombein, 1950. Proc. Hawaii. Entomol. Soc., 14: 127 [Marianas, Carolines].
- Megachile caecina* Cameron, 1903. J. Str. Br. Roy. Asia. Soc., (39): 173 [female; Trusan].
- Megachile borneana* Cameron, 1903. J. Str. Br. Roy. Asia. Soc., (39): 174 [female; Kuching].
- Megachile gadara* Cameron, 1903. J. Str. Br. Roy. Asia. Soc., (39): 176 [male; Kuching].
- Megachile robii* Ashmead, 1904. Proc. U. S. Nat. Mus., 28: 128 [female; Manila].
- Megachile semperi* Friese, 1905. Ztschr. Hym. Dipt., 5: 17 [female; Palau]; Yasumatsu, 1935, Mushi, 8: 95 [Tinian]; Cockerell, 1939. Occas. Papers B. P. Bishop Mus., 15: 63; Yasumatsu, 1939. Tenthredo, 2: 335 [Marianas, Carolines, Palau].
- Megachile varidens* Cameron, 1905. J. Str. Br. Roy. Asia Soc.,(44): 166 [male; Kuching].
- Megachile metallescens* Cockerell, 1918. Phil. J. Sci., 13: 135 [female; Luzon].
- Megachile mcgregori* Cockerell, 1918. Phil. J. Sci., 13: 140 [male; Luzon].

This species is widely distributed in Marianas and Carolines in Micronesia. Krombein (1950) pointed out that some variation was found in the amount of black hairs in the scopa of the fifth sternum. AU the specimens collected by the present expedition show normal state, *i.e.*, having black scopa only laterally on the segment.

Specimens examined: 2 females, Alamagan I., N. Mariana Is., 9. v. 1992 (S. Miyano); 3 females, same data as above except 19. v. 1992; 3 females and 2 males, Anatahan I., N. Mariana Is., 11. v. 1992 (S. Miyano); 1 male, Pagan I., N. Mariana Is., 24. v. (S. Miyano); 3 females and 2 males, Agrihan I., N. Mariana Is., 28. v. 1992 (S. Miyano); 3 females and 1 male, same data as above except 29. v. 1992; 6 females, same data as above except 30. v. 1992; 1 female and 1 male, same data as above except 31. v. 1992.

Distribution: Mariana Is. (Agrihan I., Pagan I., *Alamagan I., *Anatahan I., Saipan I., Tinian I., Rota I., Guam I.), Caroline Is.(Palau I., Yap I., Truk I., Ponape I., Kusaie Atoll), Philippines and Borneo.

Family Anthophoridae

6. *Xylocopa bmsilianorum varipuncta* Patton, 1879 (Fig. 3F)

Xylocopa varipuncta Patton, 1879. Canad. Ent., 11: 60 [female; Arizona].

Xylocopa brusiliunorum varipuncta: Ackerman, 1916. J. N. Y. Ent. Soc., 24: 226; Krombein, 1950. Proc. Hawaii. Entomol. Soc., 14: 133 [Saipan, Guam].

Krombein (1950) noted that this species was introduced to the Marianas from Hawaii in the 1940's.

Specimens examined: 3 females, Garapan, Saipan I., S. Mariana Is. 21. v. 1992 (S. Miyano).

Distribution: Mariana Is. (Saipan I., Guam I.), Hawaii and North America.

Family Apidae

7. *Apis mellifera* Linnaeus, 1758

Apis mellifera Linnaeus, 1758. Syst. Nat., 10th Edit., p. 576; Fullaway, 1913. Proc. Hawaii. Ent. Soc., 2: 282 [Guam]; Esaki, 1936. Mushi, 9: 44 [Koror, Palaus]; Cockerell, 1942. B. P. Bishop Mus. Bull., 172: 188 [Guam]; Townes, 1947. Rpt. 14, U.S. Comm. Co. Surv. Micronesia, p. 51 [Ponape, Palaus, southern Marianas]; Krombein, 1950. Proc. Hawaii. Entomol. Soc., 14: 135 [Marianas, Carolines].

Fullaway (1913) noted that this species was introduced to Guam from Hawaii in 1907.

Specimens examined: 1 worker, Mt. Tapotchao, Saipan I., S. Mariana Is., 7. v. 1992 (S. Miyano); 1 worker, Garapan, Saipan I., S. Mariana Is., 21. v. 1992 (S. Miyano); 2 workers, Pagan I., N. Mariana Is., 24. v. 1992 (S. Miyano); 4 workers, Rota I., S. Mariana Is., 13. vi. 1992 (S. Miyano).

Distribution (*only* cited from Micronesia): Mariana Is. (*Pagan I., Saipan I., *Rota I., Guam I.), Caroline Is. (Palau I., Ponape I.).

CHARACTERISTIC OF BEE FAUNA OF THE NORTHERN MARIANA ISLANDS

Table 1 shows a summary of bee fauna in the Bonin Islands and Micronesia based on Krombein (1955) and the present data. The Southern Mariana Islands appear to have the richest fauna (14 species) and the highest number of endemic species (8 species), followed by Palau Island (10 and 6 species) in Carolines. It also shows the Bonin Islands have the highest endemism (87.5%) although the fauna is not very rich. As generally reported in insects of the Pacific Islands, the table shows the numbers of species and endemics in decreasing order from west to east in Carolines in the Pacific Ocean. It also indicates a drop of the species number and endemics between the Bonin Islands and the Southern Mariana Islands.

Table 2 shows distribution of bees for each island in the Marianas with total numbers in the Carolines and Marshalls. The percentage of endemism in the bees (66.7%) in Micronesia is much higher than those in other insects, (e.g., wasps, 44.2%, Krombein, 1950; Dermaptera, 40.0%, Brindley, 1972). The Southern Marianas have 14 species including 7 endemics, while the Northern Marianas have 6 including 2 endemics. Gressitt et al. (1961) stated "Going northward from Guam and southward from the Bonin Islands there is an impoverishment, in the Volcano and Northern Mariana Islands, related to greater distance from continental islands as well as to smaller size and younger nature of the islands". The present expedition supplied some lacks of faunal information in the Northern Marianas, and revealed them to have a moderate bee fauna including a few endemics.

Figure 4 shows proportions of the numbers of components for Northern (A) and Southern (B) Mariana Islands. The feature of bee fauna in the Northern Islands is poor in endemics. Five of six species recorded from the Northern Islands are in common with those from the Southern Islands and no common species with the Bonin Islands except for *Apis mellifera*. Fennah (1956) noted the discontinuity between the Marianas and the Bonins in discussing Micronesian Fulgoroidea (Homoptera). The bee fauna gives support to his conclusion. Table 3 shows a matrix of Nomura-Shimpson's coefficients (NSC) among the 10 islands shown in Table 1. The coefficient is calculated for

Table 2. Distribution of bees for each island in the Mariana Islands with total numbers of Carolines and Marshalls. Codes for islands are as follows. Mg: Maug I.; As: Asuncion I.; Ag: Agrihan I.; P: Pagan I.; Al: Alamagan I.; Gg: Guguan I.; An: Anatahan I.; S: Saipan I.; T: Tinian I.; R: Rota I.; Gm: Guam I.; C: Caroline Is.; Ms: Marshall Is.

Species name	Mg	As	Ag	P	Al	Gg	An	S	T	R	Gm	C	Ms
Colletidae													
<i>Hylaeus guatnensis</i>											X		
<i>H. rotensis</i>										X			
<i>H. yapensis</i>												X	
<i>H. hirticaudus</i>												X	
Halictidae													
<i>Halictus yapensis</i>												X	
<i>Homalictus palaonicus</i>												X	
<i>H. nummatus</i>												X	
<i>H. auriger</i>												X	
<i>H. swezeyi</i>								X		X	X		
<i>H. rotaensis</i>									X	X			
<i>H. saffordi</i>											X		
<i>H. vexator</i>			X	X		X							
<i>Lasioglossum miyanoi</i>										X			
Megachilidae													
<i>Lithurge scabrosus</i>	X	X				X		X	X		X	X	
<i>Heriades paganensis</i>				X				X	X		X		
<i>H. plumosa</i>												X	
<i>Megachile umbripennis</i>								X					
<i>M. fullawayi</i>	X		X	X			X				X	X	X
<i>M. laticeps</i>			X	X	X		X	X	X	X	X	X	
<i>M. palaonica</i>												X	
<i>M. diligens hedleyi</i>												X	X
Anthophoridae													
<i>Ceratina mariannensis</i>								X		X			
<i>C. palauensis</i>												X	
<i>Xylocopa brasilianorum varipuncta</i>								X			X		
Apidae													
<i>Trigona fuscobalteata</i>												X	
<i>T. iridipennis</i>												X	
<i>Apis mellifera</i>				X				X		X	X	X	
Total sp. no	2	0	4	5	1	2	2	8	4	7	9	16	2

Table 3. A matrix of Nomura-Shimpson’s coefficients among ten islands in Micronesia.

	B	N.M.	S.M.	C	Pa	Y	T	Po	K	M
Bonin Is.	—									
N. Mariana Is.	0.17	—								
S. Mariana Is.	0.13	0.83	—							
Caroline Is.	0.13	0.67	0.29	—						
Palau I.	0.10	0.50	0.30	—	—					
Yap I.	0.00	0.33	0.29	—	0.71	—				
Truk I.	0.00	0.50	0.50	—	0.67	0.67	—			
Ponape I.	0.20	0.60	0.60	—	0.80	0.60	0.60	—		
Kusaie I.	0.00	0.75	0.75	—	0.50	0.50	0.75	0.75	—	
Marshall Is.	0.00	0.50	0.50	1.00	0.00	0.00	0.50	0.00	0.50	—

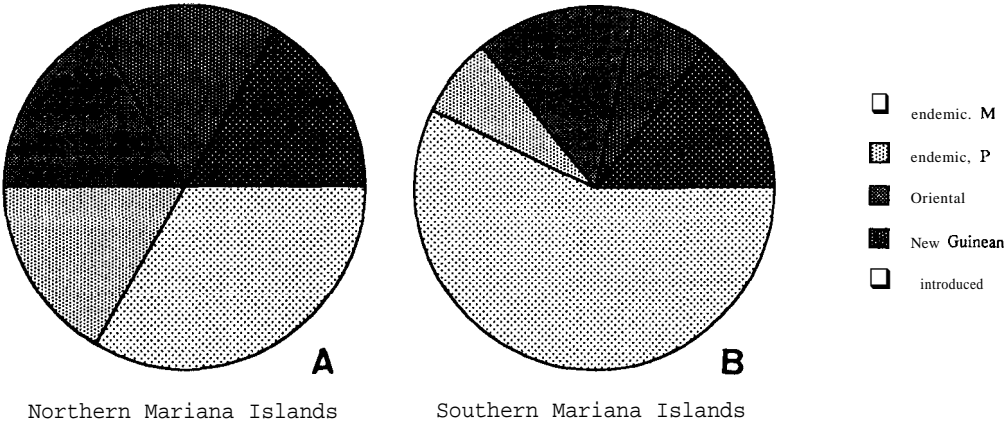


Fig. 4. Proportion of the numbers of components for Northern (A) and Southern (B) Mariana Islands. Endemic, M: endemic to Mariana Is.; endemic, P: endemic to Pacific Is.

each pair of islands as follows: c/b ($a \geq b$), where a is the number of species on A island, b is that on B island and c is that in common. The table shows the Northern Marianas have the highest value (0.83) with the Southern Marianas, followed by Kusaie (0.75) and Carolines (0.67). The fauna of the Northern Marianas is strongly related to that of the Southern Marianas and is disharmonic in

components. Only two species, *Homalictus vexator* and *Heriades paganensis* are endemic to the Northern Islands. Three species of Megachilidae are widely distributed in the Pacific Islands, including one originating from the Oriental Region and one from the New Guinean. *Apis mellifera* was introduced from Hawaii through the Southern Islands.

ACKNOWLEDGEMENTS

I am deeply indebted to Dr. S. Miyano of the Natural History Museum & Institute, Chiba, for his giving me an opportunity of examining materials collected on the expedition. I am also thankful to Prof. K. Morimoto of Kyushu Univ. and Prof. Emeritus G. T. Riegel of Eastern Illinois Univ. for their reading the manuscript.

REFERENCES

- Brindle, A., 1972. Dermaptera. Insects of Micronesia, *B. P. Bishop Mus.*, 5: 97-171.
- Cockerell, T. D. A., 1942. Insects of Guam – I. Hymenoptera. Bees of Guam. Halictine bees from Rota Islands. *B. P. Bishop Mus. Bull.*, 172: 189.
- Fennah, R. G., 1956. Homoptera: Fulgoroidea. Insects of Micronesia, *B. P. Bishop Mus.*, 6: 39-211.
- Fullaway, 1913. Report on a collection of Hymenoptera made in Guam, Marianne Islands. *Proc. Hawaii. Entomol. Soc.*, 2: 282-290.
- Gressitt, J. L., T. C. Maa, I. M. Mackerras, S. Nakata, & L. W. Quate, 1961. Problems in the zoogeography of Pacific and Antarctic insects. *Pac. Insects Monogr.*, 2: 1-94.
- Krombein, K. V., 1950. The Aculeate Hymenoptera of Micronesia II. Colletidae, Halictidae, Megachilidae, and Apidae. *Proc. Hawaii. Entomol. Soc.*, 14: 101-142.
- Townes, 1947. *Rpt. 14, U.S. Comm. Co. Surv. Micronesia.*
- Yasumatsu, K., 1935. Notes on two Apoidea collected by Prof. Tohru Uchida on the Mariana and West Caroline Islands. *Mushi*, 8: 94-96.
- , 1939a. Apoidea of Micronesia (Hymenoptera). *Tenthredo*, 2: 229-338, pls. 9-13.
- , 1939b. Apoidea of Micronesia II. Ceratinidae. *Tenthredo*, 2: 344-347.
- , 1942. Apoidea of Micronesia. III. Records of the genera *Megachile*, *Heriades*, *Ceratina* and *Prosopis*. *Tenthredo*, 3: 335-348, pl.